

IN THE CLAIMS:

Please add new claims 34 through 42, and amend claims 1, 4, 7, 8, 9 and 25 — all as set forth below.

1    1. (currently amended) Apparatus for printing a desired  
2    image on a printing medium, based upon input image data, by  
3    construction from individual marks of at least one colorant,  
4    formed in a pixel grid; said apparatus comprising:

5        for each colorant, at least one respective multielement  
6        incremental- printing array that is subject to colorant-depo-  
7        sition error;

8        means for measuring such colorant-deposition error of the  
9        at least one array;

10      means for modifying a multicolumn, multirow numerical  
11     tabulation that forms a mapping between such input image data  
12     and such marks, to compensate for the measured colorant-depo-  
13     sition error; and

14      means for printing using the modified mapping.

1    2. (original) The apparatus of claim 1, wherein the mapping  
2    is selected from the group consisting of:

3        an optical-density transformation of the image data to  
4        such construction from individual marks; and

5        a spatial-resolution relationship between the image data  
6        and such pixel grid.

1       3. (original) The apparatus of claim 2, wherein:  
2              the optical-density transformation comprises a halftoning  
3          matrix; and  
4              the spatial-resolution relationship comprises a scaling  
5          of the image data to such pixel grid.

1       4. (currently amended) The apparatus of claim 1, wherein:  
2              said at least one multielement incremental-printing ar-  
3          ray comprises a plurality of multielement printing arrays that  
4          print in a corresponding plurality of different colors or col-  
5          or dilutions, respectively, each multielement printing array  
6          being subject to a respective colorant-deposition error; and  
7              the measuring means and the mapping-modifying means each  
8          operate with respect to each one of the plurality of multiele-  
9          ment printing arrays respectively.

1       5. (original) The apparatus of claim 4, wherein:  
2              for at least one of the plurality of multielement print-  
3          ing arrays, the colorant-deposition error comprises a respec-  
4          tive pattern of printing-density defects; and wherein:  
5              the measuring means comprise means for measuring the  
6          pattern of printing-density defects for each multielement  
7          printing array respectively; and  
8              the modifying means comprising means for applying the  
9          respective pattern of defects, for at least one of the mul-  
10         tielement printing arrays, to modify a respective said map-  
11         ping.

1       6. (original) The apparatus of claim 4, wherein:  
2                 for at least one of the plurality of multielement print-  
3                 ing arrays, the colorant-deposition error comprises a swath-  
4                 height error;  
5                 the measuring means comprise means for measuring the  
6                 swath-height error for each multielement printing array re-  
7                 spectively; and  
8                 the modifying means comprise means for applying the  
9                 respective swath-height error, for at least one of the  
10                multielement printing arrays, to modify a respective said  
11                mapping.

1       7. (currently amended) The apparatus of claim 1, wherein:  
2                 the colorant-deposition error comprises a pattern of  
3                 printing-density defects;  
4                 the measuring means comprise means for measuring the  
5                 pattern of printing-density defects;  
6                 the modifying means comprise:  
7                         means for deriving a correction pattern from  
8                         the measured pattern of printing-density de-  
9                         fects, and  
10                         means for applying the correction pattern to modify  
11                         a halftone thresholding process; and  
12                         for each colorant, the printing means comprise means for  
13                         printing such image incrementally, using the modified halftone  
14                         thresholding process.  
15  
16  
17

1       8. (currently amended) The apparatus of claim 1, wherein:  
2              the colorant-deposition error comprises a swath-height  
3              error or otherwise corresponds to an optimum distance of  
4              printing-medium advance;  
5              the measuring means comprise means for measuring the  
6              swath-height error or determining the optimum distance;  
7              the modifying means comprise:  
8  
9                  means for deriving a correction pattern from the  
10                 measured swath-height error or determined opti-  
11                 mum distance, and  
12  
13                 means for applying the correction pattern to modify  
14                 a halftone thresholding process; and  
15  
16                 for each colorant, the printing means comprise means for  
17                 printing such image incrementally, using the modified halftone  
18                 thresholding process.

1       9. (currently amended) A method of printing a desired image,  
2       by construction from individual marks of at least one color-  
3       ant, formed in a pixel grid by at least one multielement  
4       printing array that is subject to a pattern of printing-den-  
5       sity defects; said method comprising the steps of:

6              measuring such pattern of printing-density defects;

7              deriving a correction pattern from the measured pattern  
8        of printing-density defects;

9              applying the correction pattern to modify a halftone  
10       thresholding process; and

11              for each said colorant, printing such image by said at  
12       least one multielement array respectively, using the modified  
13       halftone thresholding process.

1       10. (original) The method of claim 9, for use with a print-  
2       mask in plural-pass printing, and further comprising the steps  
3       of, before or as a part of the applying step:

4              using such printmask to determine a relationship between  
5       the halftone matrix and the multielement array; and

6              employing the relationship in the applying step to con-  
7       trol application of the correction pattern to the halftone  
8       matrix.

1       11. (original) The method of claim 9, wherein:

2              the printing step comprises single-pass printing.

1       12. (original) The method of claim 9, for use with said at  
2       least one multielement incremental-printing array that com-  
3       prises a plurality of scanning multielement printing arrays  
4       that print in a corresponding plurality of different colors or  
5       color dilutions, each multielement printing array being sub-  
6       ject to a respective swath-height error; and wherein:

7               the measuring, deriving, applying and printing steps are  
8       employed to modify swath height of at least one of the scan-  
9       ning multielement printing arrays, for accommodating any  
10      swath-height error present in each multielement printing array  
11      respectively.

1       13. (original) The method of claim 9, for use with said at  
2       least one multielement incremental-printing array that compri-  
3       ses a plurality of multielement printing arrays that print in  
4       a corresponding plurality of different colors or color dilu-  
5       tions, each multielement printing array being subject to a  
6       respective pattern of printing-density defects; and wherein:

7               the measuring, deriving, applying and printing steps are  
8       each performed with respect to each multielement printing  
9       array respectively.

1       14. (original) The method of claim 13, for use with such  
2       plurality of multielement incremental-printing arrays that are  
3       also each subject to a respective swath-height error; and  
4       wherein:

5                 the measuring, deriving, applying and printing steps are  
6       also employed to modify swath height of at least one of the  
7       multielement printing arrays, for accommodating any swath-  
8       height error present in each multielement printing array  
9       respectively.

1       15. (original) The method of claim 9, wherein:

2                 the halftone thresholding process comprises definition of  
3       a halftone matrix.

1       16. (original) The method of claim 9, wherein:

2                 the halftone thresholding process comprises an error-  
3       diffusion protocol.

1       17. (original) The method of claim 16, wherein the error-  
2       diffusion protocol comprises at least one of:

3                 a progressive error-distribution allocation protocol of  
4       such error-diffusion halftoning; and  
5                 a decisional protocol for determining whether to mark a  
6       particular pixel.

1       18. (original) The method of claim 9, wherein:

2                 the applying step comprises replacing values above or  
3       below a threshold value.

1       19. (original) The method of claim 9, wherein:  
2                  the applying step comprises multiplying values by a  
3                  linear factor.

1       20. (original) The method of claim 9, wherein:  
2                  the applying step comprises applying a gamma correction  
3                  function to values.

1       21. (original) The method of claim 9, wherein the modifying  
2                  step comprises a combination of at least two of:  
3                  replacing values above or below a threshold value;  
4                  multiplying each values by a linear factor; and  
5                  applying a gamma correction function to values.

1       22. (original) The method of claim 9, wherein:  
2                  for each of the plurality of multielement arrays, the  
3                  measuring, deriving and applying steps are each performed at  
4                  most only one time for a full image.

1       23. (original) The method of claim 9, wherein:  
2                  the applying step comprises modifying the darkness of  
3                  substantially each mark printed by an individual printing  
4                  element whose density is defective.

1       24. (original) The method of claim 9, wherein:  
2                  the applying step comprises modifying the average number  
3                  of dots printed by an individual printing element whose den-  
4                  sity is defective.

1       25. (currently amended) A method of printing a desired im-  
2                  age, based on input image data, by construction from individu-  
3                  al marks of at least one colorant, formed in a pixel grid by  
4                  at least one scanning multielement printing array; said print-  
5                  ing being subject to print-quality defects due to departure of  
6                  printing-medium advance from an optimum value; said method  
7                  comprising the steps of:

8                  measuring a parameter related to such print-quality  
9                  defects;

10                 based on the measured parameter, scaling such input image  
11                  data to compensate for said departure; and

12                 for each said colorant, printing such marks with said at  
13                 least one scanning multielement array image using the scaled  
14                  input image data.

1       26. (original) The method of claim 25, wherein:  
2                  the parameter comprises such print-quality defects; and  
3                  the measuring step comprises measuring such print-quality  
4                  defects.

1       27. (original) The method of claim 26, wherein:  
2                  the defects comprise swath-height error; and  
3                  the measuring step comprises measuring swath-height  
4                  error.

1       28. (original) The method of claim 26, wherein:  
2              the defects comprise area-fill nonuniformity; and  
3              the measuring step comprises:  
4  
5                  using a sensing system to measure area-fill non-  
6                  uniformity for plural printing-medium advance  
7                  values, and  
8  
9                  selecting a printing-medium advance value that cor-  
10                 responds to minimum area-fill nonuniformity.

1       29. (original) The method of claim 25, wherein:  
2              the parameter comprises such optimum value; and  
3              the measuring step comprises determining such optimum  
4              value.

1       30. (original) The method of claim 25, for use with said at  
2       least one scanning multielement printing array that comprises  
3       a plurality of multielement printing arrays that print in a  
4       corresponding plurality of different colors or color dilu-  
5       tions, each multielement printing array being subject to a  
6       respective swath-height error; wherein:  
7  
8              the measuring, scaling and printing steps are each per-  
9       formed with respect to each multielement printing array re-  
spectively.

1       31. (original) The method of claim 30, wherein the printing  
2       step comprises:

3                 comparing optimum advance values or swath-height values  
4       measured for the plurality of multielement printing arrays  
5       respectively, to find the smallest of said values;

6                 selecting a particular multielement printing array whose  
7       said value is substantially the smallest;

8                 using, in common for the plurality of printing arrays,  
9       substantially said selected smallest value; and

10                 for substantially each array other than the particular  
11      array, operating with a respective reduced number of printing  
12      elements and with rescaled data, to match an actual effective  
13      swath height of the particular array.

1       32. (original) The method of claim 31, wherein:

2                 said smallest of said values is determined taking into  
3       account the maximum available number of printing elements in  
4       the corresponding array.

1       33. (original) The method of claim 25, further comprising  
2       the step of:

3                 after the scaling step, iterating the measuring and  
4       scaling steps to allow for nonlinearity in such print-quality  
5       defects.

1       34. (new) Apparatus for printing a desired image on a print-  
2       ing medium, based upon input image data, by construction from  
3       individual marks formed in a pixel grid; said apparatus com-  
4       prising:

5               at least one multielement incremental-printing array that  
6       is subject to colorant-deposition error;

7               means for measuring such colorant-deposition error of the  
8       at least one array;

9               means for modifying a multicolumn, multirow numerical  
10      tabulation that forms a mapping between such input image data  
11      and such marks, to compensate for the measured colorant-depo-  
12      sition error; and

13               means for printing using the modified mapping;

14               wherein the multielement printing array is an inkjet  
15      printhead.

1       35. (new) A method of printing a desired image, by construc-  
2       tion from individual marks formed in a pixel grid by at least  
3       one multielement printing array that is subject to a pattern  
4       of printing-density defects; said method comprising the steps  
5       of:

6               measuring such pattern of printing-density defects;

7               deriving a correction pattern from the measured pattern  
8       of printing-density defects;

9               applying the correction pattern to modify a halftone  
10      thresholding process; and

11               printing such image using the modified halftone thresh-  
12      olding process;

13               wherein the multielement printing array is an inkjet  
14      printhead.

1       36. (new) A method of printing a desired image, based on  
2       input image data, by construction from individual marks formed  
3       in a pixel grid by at least one scanning multielement printing  
4       array; said printing being subject to print-quality defects  
5       due to departure of printing-medium advance from an optimum  
6       value; said method comprising the steps of:

7                 measuring a parameter related to such print-quality  
8       defects;

9                 based on the measured parameter, scaling such input image  
10      data to compensate for said departure; and

11                 printing such image using the scaled input image data;

12                 wherein the multielement printing array is an inkjet  
13      printhead.

1       37. (new) Apparatus for printing a desired image on a print-  
2       ing medium, based upon input image data, by construction from  
3       individual marks of at least one colorant, formed in a pixel  
4       grid; said apparatus comprising:

5                 for each colorant, respective means for printing incre-  
6       mentally in that colorant;

7                 each said printing means, for a particular one colorant,  
8       comprising at least one respective incremental-printing array  
9       that is subject to colorant-deposition error;

10                 means for measuring such colorant-deposition error of the  
11      at least one array;

12                 means for modifying a multicolumn, multirow numerical  
13      tabulation that forms a mapping between such input image data  
14      and such marks, to compensate for the measured colorant-depo-  
15      sition error; and

16                 means for printing using the modified mapping.

1       38. (new) Apparatus for printing a desired image on a print-  
2       ing medium, based upon input image data, by construction from  
3       individual marks formed in a pixel grid; said apparatus com-  
4       prising:

5               at least one multihundred-element printing array that is  
6       subject to colorant-deposition error;

7               means for measuring such colorant-deposition error of the  
8       at least one array;

9               means for modifying a multicolumn, multirow numerical  
10      tabulation that forms a mapping between such input image data  
11      and such marks, to compensate for the measured colorant-depo-  
12      sition error; and

13               means for printing using the modified mapping.

1       39. (new) The apparatus of claim 38, wherein:

2               the multihundred-element array has at least three hundred  
3       printing elements.

1       40. (new) Apparatus for printing a desired image on a print-  
2       ing medium, based upon input image data, by construction from  
3       individual marks formed in a pixel grid; said apparatus com-  
4       prising:

5               at least one multielement incremental printing array,  
6       having at least thirty printing elements, that is subject to  
7       colorant-deposition error;

8               means for measuring such colorant-deposition error of the  
9       at least one array;

10              means for modifying a multicolumn, multirow numerical  
11       tabulation that forms a mapping between such input image data  
12       and such marks, to compensate for the measured colorant-depo-  
13       sition error; and

14              means for printing using the modified mapping.

1       41. (new) The apparatus of claim 40, wherein:

2               the at least one multielement incremental printing array  
3       comprises a scanning printhead or a full-page-width printhead.

1       42. (new) The apparatus of claim 40, wherein:

2               the printing means comprise at least one microprocessor  
3       controlling all of the at least thirty elements simultaneously  
4       during printing to select, and selectively actuate, particular  
5       elements for printing of particular pixels respectively.